JASPERSE CHEM 160 PRACTICE TEST 4 VERSION 3 Ch. 19 Electrochemistry Ch. 20 Nuclear Chemistry Formulas: $E^{\circ}_{cell} = E^{\circ}_{reduction} + E^{\circ}_{oxidation}$ $G^{\circ} = -nFE^{\circ}_{cell}$ (for kJ, use F = 96.5) $E_{cell} = E^{\circ} - [0.0592/n]\log Q$ $\log K = nE^{\circ}/0.0592$ Mol $e^{-} = [A \cdot time (sec)/96,500]$ time (sec)= mol $e^{-} \cdot 96,500$ /current (in A) $t = (t_{1/2}/0.693) \ln (m_0/m_1)$ $\ln (m_0/m_1) = (0.693/t_{1/2}) \cdot t$ $E = mc^2$ (m in kg, E in J, c = 3x10⁸ m/s)

- 1. What is the oxidation number of S in $KHSO_4$?
 - a. +3
 - b. +6
 - c. +7
 - d. +12
 - e. none of the above
- 2. Balance the following reaction. How many electrons would be transferred?

 $HNO_3 + FeO \rightarrow NO + Fe_2O_3 + H_2O$

- a. 2
- b. 3
- c. 4
- d. 6 e. none of the above
- 3. Balance the following reaction. What would be the coefficient for NbCl₂?

 $H_2O + H_2SO_3 + NbCl_5 \rightarrow H_2SO_4 + NbCl_2 + HCl$

- a. 1
- b. 2
- c. 3
- d. 4
- e. none of the above
- 4. Which substance is the oxidizing agent in a car battery, in the reaction shown below?

 $Pb + PbO_2 + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O$

a. Pb b. PbO₂ c. H_2SO_4 d. PbSO₄

- 5. Which transformation could not take place at the cathode of an electrochemical cell?
 - a. NiBr₂ to Ni and Br⁻
 - b. Cl_2 to Cl^-
 - c. $H_2^{\uparrow}O$ to H_2 and OH^{-} d. $H_2^{\downarrow}O$ to H^{+} and O_2^{-}
- 6. Molten PbCl₂ is subjected to electrolysis in order to form elemental lead and chlorine. Which of the following is true?
 - a. Elemental chlorine gas is formed at the cathode and bubbles away
 - b. Elemental lead metal is formed and deposited at the anode
 - c. Electrons flow from the cathode to the anode
 - d. Chloride ions are the reducing agents in the reaction
 - e. none of the above
- 7. The standard reduction potentials for Pb^{2+} and Ag^{+} are -0.13 and +0.80V respectively. Calculate E° for a cell in which the overall reaction is:

 $Pb + 2Ag^+ \rightarrow Pb^{2+} + 2Ag$

- a. 0.93V
- b. 0.67V
- c. 1.73 V
- d. 1.47 V
- e. none of the above
- 8. Consider the following half-reactions and voltages. What will be the E° for an electrochemical cell involving the chemicals shown?

Reduction Potentials			
$F_2 \rightarrow 2F^-$	2.87		
$A\bar{l}^{3+} \rightarrow Al$	-1.66V		

- a. -3.8 V
- b. 4.53 V
- c. 1.21 V
- d. 2.6 V
- e. none of the above
- 9. What is the standard reduction potential for Na⁺, given the following information:

 $Na/Na^{+}//Pb^{2+}/Pb$ $E^{\circ} = 2.58 V$

 $Pb^{2+} + 2e^{-} \rightarrow Pb^{2+} E^{\circ} = -0.13 V$ a. -2.45 V b. -2.71 V c. +2.45 V d. -2.84 V e. none of the above

- 10. The standard reduction potentials for Pb^{2+} and Ni^{2+} are -0.13 and -0.28V respectively. Which of the following substances will be oxidized most easily?
 - a. Pb²⁺
 - b. Pb
 - c. Ni²⁺
 - d. Ni
- 11. Based on the periodic table and general patterns of activity, which of the following would not react with metallic Mg? AuBr₂
 - LiBr FeCl₃ HNO₃ AlCl₃ a. HNO₃ b. LiBr c. FeCl₃ d. AlCl₃
 - e. AuBr₂
- 12. Given the reduction potential for water, which of the following metals may be produced by electrolysis in aqueous solution? The standard reduction potentials of the metal ions are listed:

 $Ni^{2+} - 0.28V$ $2H_2O + 2e^- \rightarrow H_2(g) + 2OH^ E^{\circ} = -0.83 V$ $\begin{array}{l} Mn^{2+}, -0.28\,\text{V} \\ Mn^{2+}, -1.18\,\text{V} \\ Mg^{2+}, -2.38 \\ Ca^{2+}, -2.76 \\ Li^+, -3.04\,\text{V} \end{array}$ a. magnesium b. lithium c. nickel d. manganese e. calcium

13. What is the value for G° (in kJ/mol) for the following reaction? (F = 96.5 kJ/V•mol)

 $Pb + PbO_2 + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O \quad E^\circ = 2.0 V$

- a. –98
- b. +136
- c. -386 d. -193
- e. none of the above

14. The G° for a redox reaction is positive. Which of the following statements is true?

- a. The reaction is at equilibrium
- b. E° is negative
- c. The reaction is product-favored
- d. K > 1
- e. E° is positive
- f. None of the above

15. What is the value of K for the following reaction?

$$I_2 + 2Br^- \rightarrow Br_2 + 2I^- E^\circ = -0.55 V$$

a. 3.8×10^{-18} b. 2.6×10^{-19} c. 3.8×10^{18} d. 6.7×10^{-22} e. none of the above

- 16. How many seconds will be required to produce 1.0 g of chromium metal by the electrolysis of a $Cr(NO_3)_3$ solution using a current of 3.0 A?
 - a. 36 b. 6.3×10^2 c. 1.9×10^3 d. 3.7×10^3

17. What is the actual voltage for the following reaction, given the concentrations shown?

 $Ca(s) + Pb^{2+} (aq) \rightarrow Pb (s) + Ca^{2+} (aq)$ 0.15 M 3.00 M $E^{\circ} = 2.74 V$ 3.00 M

- a. 2.52 V b. 2.78 V c. 3.28 V d. 2.70 V
- e. none of the above
- 18. Which of the following statements would be false?
 - **Reduction Potentials** $Br_2 \rightarrow 2Br^-$ 1.09 V $I_2 \rightarrow 2I^-$ 0.54 V $\tilde{Cu}^{2+} \rightarrow Cu \quad 0.34 \text{ V}$ $H^+ \rightarrow H_2$ 0.00 V $Ni^{2+} \rightarrow Ni$ -0.28 V
 - a. Br_2 is the strongest oxidizing agent
 - b. Ni is the strongest reducing agent

 - c. Γ would react with Br_2 , but would not react with Cu^{2+} d. Cu would react with both Br_2 and I_2 , but would not react with either H^+ or H_2 e. Ni would react with both Br^- and Γ^-

19. Given the following reduction potentials, what is the product at the <u>anode</u> when a current is passed through an aqueous solution of FeBr₂? (Hint: remember which chemicals and ions are really in the solution and subject to the electrolysis.)

$Br_2 + 2e^- \rightarrow 2Br^-$	$E^{\circ} = 1.08 V$
$O_2 + 4H^+ \rightarrow H_2O$	$E^{\circ} = 0.82 V$
$\bar{\mathrm{Fe}^{2+}} + 2e^{-} \rightarrow \bar{\mathrm{Fe}}$	$E^\circ = -0.44 V$
$2H_2O + 2e^- \rightarrow H_2(g) + 2OH^-$	$E^\circ = -0.83 V$

- a. Fe
- b. Br_2
- c. O_2^{-1}
- d. $\overline{H_2}$ e. H_2O
- f. None of the above
- 20. Given the following information, rank the "activity" of the metals as reducing agents:

Cr reacts with NiBr₂ and CdBr₂, but not with $ZnBr_2$ Cd reacts with NiBr₂, but not with $ZnBr_2$ or $CrBr_3$

- $\begin{array}{ll} a. & Zn > Cr > Cd > Ni \\ b. & Ni > Cr > Cd > Zn \\ c. & Zn > Cr > Ni > Cd \\ d. & Zn > Cd > Cr > Ni \end{array}$
- 21. What is the missing particle for the following radioactive decay reaction?

 $^{15}O \rightarrow ^{15}N + _$

- a. alpha particle
- b. beta particle
- c. neutron
- d. gamma ray
- e. positron

22. What is the missing particle for the following radioactive decay reaction?

 $^{14}C \rightarrow ^{14}N + _$

- a. alpha particle
- b. beta particle
- c. neutron
- d. gamma ray
- e. positron

23. What is the missing particle for the following radioactive decay reaction?

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^{14}N + {}^{1}n \rightarrow {}^{1}H + \_
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- ^{13}N a.
- ^{14}C b. ^{13}C
- c. 14 O d.
- e. none of the above
- 24. What is the other product when ²³²Th undergoes alpha emission??
 - ²³⁶U a.
 - b. ²³²Pa
 - c. ²²⁸Ra d. ²²⁸Rn

 - e. none of the above
- 25. Which of the following is true when a nuclide emits a positron?
 - a. The mass number and atomic number increase
 - b. The mass number increases
 - c. The atomic number decreases
 - d. The nuclide is unchanged
 - e. None of the above
- 26. Cs-137 has a half-life of 30 years. How much of a 240g sample will remain after 120 years?
 - a. 30 g
 - b. 15 g
 - c. 7.0 g
 - d. 2.8 g
 - e. none of the above
- 27. C-14 has a half-life of 5730 years. The C-14 in a sample of cotton is found to have a disintegration rate of 10.4 (disintegrations/gram-minute). The disintegration rate of "live" carbon is 15.3. What is the age of the cotton sample?
 - a. 3110 years
 - b. 3190 years
 - c. 3320 years
 - d. 3440 years
 - e. none of the above

- 28. A 3.60 g sample of a radioactive isotope decays to 1.62 g over a period of 35 days. What is the half–life of the isotope?
 - a. 29.2 days
 - b. 30.4 days
 - c. 31.7 days
 - d. 32.5 days
 - e. none of the above

29. What is the binding energy in kJ/mol for $\frac{4}{2}$ He, given the following respective masses?

Neutron: 1.00867 Proton: 1.00783 He-4: 4.00150 a. $5.09 \times 10^{10} \text{ kJ/mol}$ b. $2.84 \times 10^9 \text{ kJ/mol}$ c. $7.48 \times 10^{12} \text{ kJ/mol}$ d. $4.22 \times 10^{10} \text{ kJ/mol}$ e. none of the above

30. Which of the following statements is true:

- a. Fission reactions involve the combination of two smaller nuclides to make a larger nuclide
- b. Fusion involves the splitting of larger nuclides into smaller nuclides
- c. In both fission and fusion reactions, energy is released because the mass of the product nuclides is greater then the mass of the reactant nuclides
- d. The mass of a nuclide is greater then the sum of the masses of it's constituent protons and neutrons
- e. Protons attract each other, and this explains why a nucleus holds together
- 31. Which of these nuclides is certain to be radioactive?

$$\frac{12}{6}C \qquad \qquad \frac{21}{13}Al \qquad \qquad \frac{103}{45}Rh \qquad \qquad \frac{263}{103}Lr$$

- a. $\frac{12}{6}$ C is the only radioactive nuclide b. $\frac{21}{13}$ Al is the only radioactive nuclide
- c. $\frac{263}{103}$ Lr is the only radioactive nuclide
- d. $\frac{21}{13}$ Al and $\frac{263}{103}$ Lr are both radioactive
- e. $\frac{21}{13}$ Al, $\frac{263}{103}$ Lr and $\frac{103}{45}$ Rh are all radioactive

- 32. Fact: ¹⁹O is unstable and radioactive. Is its n/p ratio too high or too low? In that case, which process could lead to stability, and what nuclide would be produced?
 - a. Its n/p ratio is <u>too low</u>, it should undergo <u>electron capture</u> to produce ^{19}N
 - b. Its n/p ratio is too low, it should undergo $\overline{alpha emission}$ to produce ²³Ne
 - c. Its n/p ratio is $\overline{too low}$, it should undergo either <u>electron capture or positron emission</u> to produce ¹⁹F.
 - d. Its n/p ratio is <u>too high</u>, it should undergo <u>beta emission</u> to produce 19 F.
 - e. Its n/p ratio is too high, it should undergo positron emission to produce 19 F.

- 33. The standard reduction potentials for Sn^{2+}/Sn (E°=-0.14) and Cu²⁺/Cu (E°=+0.34). For an electrochemical cell involving Sn and Cu, which of the following statements is true?
 - a. Copper is oxidized and serves as the anode
 - b. Tin is reduced and serves as the cathode
 - c. The oxidizing agent is Cu^{2+}
 - d. The reducing agent is Cu
 - e. The cathode metal electrode will dissolve away as the reaction procedes

Answers,	Test4	-160-	Version 3
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Electrochemistry and Nuclear Chemistry

1. B	18. E
2. D	19. C
3. B	20. A
4. B	21. E
5. D	22. B
6. D	23. B
7. A	24. C
8. B	25. C
9. B	26. B
10. B	27. B
11. B	28. B
12. C	29. B
13. C	30. C
14. B	31. D
15. B	32. D
16. C	33. C
17. D	